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“Step Out From the Old to the New”

IS 9551-3 (2002): High Fidelity Audio Equipment and Systems
: Minimum Performance Requirements, Part 3: Loudspeakers
[LITD 7: Audio, Video and Multimedia Systems and Equipment]



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Bhartrhari—Nitiśatakam

“Knowledge is such a treasure which cannot be stolen”

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उच्च तद्रूपता वाले श्रव्य उपस्कर एवं तंत्र
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भाग 3 लाउडस्पीकर
(पहला पुनरीक्षण)

Indian Standard
HIGH FIDELITY AUDIO EQUIPMENT AND SYSTEMS :
MINIMUM PERFORMANCE REQUIREMENTS
PART 3 LOUDSPEAKERS
(*First Revision*)

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NATIONAL FOREWORD

This Indian Standard (Part 3) (First Revision) which is identical with IEC 60581-7 (1986) 'High fidelity audio equipment and systems; Minimum preformance requirements — Part 7 : Loudspeakers' issued by the International Electrotechnical Commission (IEC) was adopted by the Bureau of Indian Standards on the recommendation of Acoustics and Recording Sectional Committee and approval of the Electronics and Telecommunication Division Council.

This Indian Standard was first published in 1979 and was based on the following documents:

IEC 29B (Secretariat) 133 Loudspeakers for hi-fi audio equipment

DIN 45500 Blatt 7-1971 Hi-fi techniques, requirements for loudspeakers

This revision has been undertaken to align it with the corresponding IEC Standard. This standard is applicable to loudspeakers for domestic use only. The text of the IEC Standard has been approved as suitable for publication as Indian Standard without deviations. Certain conventions are, however, not identical to those used in Indian Standards. Attention is particularly drawn to the following:

- a) Wherever the words 'International Standard' appear referring to this standard, they should be read as 'Indian Standard'.
- b) Comma (,) has been used as a decimal marker while in Indian Standards, the current practice is to use a point (.) as the decimal marker.

Only the English language text in the International Standard has been retained while adopting it in this standard.

CROSS REFERENCES

In this adopted standard, reference appears to certain International Standards for which Indian Standards also exist. The corresponding Indian Standards which are to be substituted in their place are listed below along with their degree of equivalence for the editions indicated:

<i>International Standard</i>	<i>Corresponding Indian Standard</i>	<i>Degree of Equivalence</i>
IEC 268-5 (1972) Sound system equipment — Part 5 : Loudspeakers (since revised in 1989)	IS 9302 (Part 4) : 1993 Characteristics and methods of measurement for sound system equipment: Part 4 Loudspeakers	Identical
IEC 268-15 (1978) Sound system equipment — Part 15 : Preferred matching values for the interconnection of sound system components	IS 9302 (Part 10) : 1980 Characteristics and methods of measurement for sound system equipment: Part 10 Preferred matching values for the interconnection of sound system components	Technically equivalent
IEC 581-1 (1977) High fidelity audio equipment and systems; Minimum performance requirements — Part 1 : General	IS 9551 (Part 1) : 2001 Specification for high fidelity audio equipment and systems : Part 1 General (<i>first revision</i>)	do

The technical committee responsible for the preparation of this standard has reviewed the provisions of the following international standards and has decided that these are acceptable for use in conjunction with this standard:

IEC 268-11 (1981)	Sound system equipment — Part 11 : Circular connectors for interconnection of sound system components
IEC 581-8 (1986)	High fidelity audio equipment and systems; Minimum performance requirements — Part 8 : Combination equipment

Indian Standard

HIGH FIDELITY AUDIO EQUIPMENT AND SYSTEMS :
MINIMUM PERFORMANCE REQUIREMENTS

PART 3 LOUDSPEAKERS

(*First Revision*)

1. Scope

This part applies to loudspeakers and loudspeaker systems which are provided with a baffle or enclosure. It also applies to systems intended to be assembled by the user (so-called "loud-speaker kits") provided that the instructions for assembly meet certain requirements (see Clause 16). The minimum requirements of this part then apply to the complete device, together with the baffle or enclosure. This part is not applicable to loudspeakers and loud-speaker systems comprising active components. For the combination of loudspeakers and amplifiers reference is made to IEC Publication 581-8: High Fidelity Audio Equipment and Systems; Minimum Performance Requirements, Part 8: Combination Equipment. This standard is not applicable to unmounted loudspeaker units.

2. Object

While currently available techniques for objective measurements do not allow complete assessment of the quality of reproduction from loudspeakers, nevertheless, objective measurements can provide essential information about the performance quality.

The object of this standard is to give the minimum performance requirements and methods of measurement for loudspeakers and loudspeaker systems having regard to the above constraints.

3. Measuring conditions

All measurements shall be made in accordance with the general measuring conditions stated in IEC Publication 581-1: High Fidelity Audio Equipment and Systems; Minimum Performance Requirements, Part 1: General, and with the conditions of measurement given in IEC Publication 268-5: Sound System Equipment, Part 5: Loudspeakers. (Under revision.)

Note. — It should be borne in mind that the accuracy of acoustic measurements at low frequencies is severely reduced by the limited size of available anechoic and reverberant rooms, and the numerous sources of error which affect measurements in the open air. According to the clause of IEC Publication 268-5 "Accuracy of acoustic measurements", the frequency range over which the total errors do not exceed ± 2 dB shall be stated.

- 3.1 Measurements shall be made with $\frac{1}{3}$ octave band filtered pink noise, unless otherwise stated, and shall be referred to a distance of 1 m. The longer axis of a loudspeaker system is considered to be the vertical axis, unless otherwise stated by the manufacturer.
- 3.2 Owing to the existence of many types of loudspeakers with different acoustical properties and intended for different acoustical environments, it is not possible to specify a single standard acoustical environment in which the tests are to be carried out. The manufacturer shall therefore specify this environment, selecting from the following:

- a) *Free field*, according to the provision of IEC Publication 268-5 "Free field conditions" for loudspeakers intended for free-standing.
- b) *Half space*, for which methods of measurement are under consideration for loudspeakers intended for wall or shelf mounting.

Pending the completion of the studies, the spatial relationship between the auxiliary baffle and the loudspeaker enclosure shall be in accordance with Figure 1 (flush mounting), while the size of the auxiliary baffle shall be $5.5\text{ m} \times 5.5\text{ m}$ minimum ($\frac{1}{2}$ wavelength at 30 Hz).

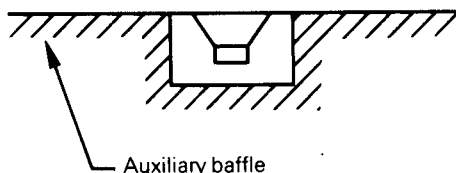


FIGURE 1

Note. — For production control purposes, manufacturers may use a measuring environment differing from that specified in Items a) or b) of Sub-clause 3.2. It is the manufacturer's responsibility to establish a reliable correlation between measurements made in the specified environment and that actually employed.

3.3 Measurement in reverberant conditions and the relevant performance specifications are under consideration.

4. Minimum requirements

The minimum requirements given in Clauses 6 to 16 apply to specifications in half space as well as to specifications in free field.

5. Basic characteristics on which the specifications depend

5.1 Characteristic power

This is the power that produces a characteristic sound pressure level according to the provision of IEC Publication 268-5 "Sound pressure level in a stated frequency band" of 94 dB at a distance of 1 m using a fixed frequency range of 100 Hz to 8000 Hz. The rated value is the value stated by the manufacturer.

5.1.1 Method of measurement

According to the clause of IEC Publication 268-5 "Sound pressure in a stated frequency band" but using a fixed frequency range of 100 Hz and 8000 Hz, these being the mid-band frequencies f_m (geometrical means between the upper and lower limiting frequencies) of the corresponding $\frac{1}{3}$ octave bands.

Note. — The characteristic power should be considered in relation to the rated power of the amplifier, to ensure that sufficient sound pressure level can be achieved. The sound pressure level to be regarded as sufficient cannot be standardized and can only be determined by the user in terms of the required loudness of reproduction.

5.2 Mean characteristic sound pressure level

5.2.1 Method of measurement

According to the clause of IEC Publication 268-5 "Mean sound pressure in a stated frequency band", but using a fixed frequency range of 100 Hz to 8000 Hz, 100 Hz and 8000 Hz being the centre frequencies of the corresponding $\frac{1}{3}$ octave bands.

The mean characteristic sound pressure level (s.p.l.) can be calculated from the relation:

$$\text{mean characteristic s.p.l.} = 20 \lg \frac{p_m}{p_o}$$

where:

p_o = standard reference sound pressure (20 μ Pa)

p_m = mean characteristic sound pressure

$$p_m = \left[\frac{1}{n} \sum_{i=1}^{i=n} p_i^2 \right]^{1/2}$$

where:

p_i = characteristic sound pressure level in the i th $\frac{1}{3}$ octave band

n = total number of bands

here, $n = 20$ due to the limitation of the frequency range to 100 Hz to 8000 Hz

If the mean characteristic sound pressure level is determined at an input power of 1 W in each $\frac{1}{3}$ octave band the characteristic power of Sub-clause 5.1 can be calculated from the relation:

$$P_{ch} = 10^x$$

where:

$$x = \frac{94 - L(p_m)}{10}$$

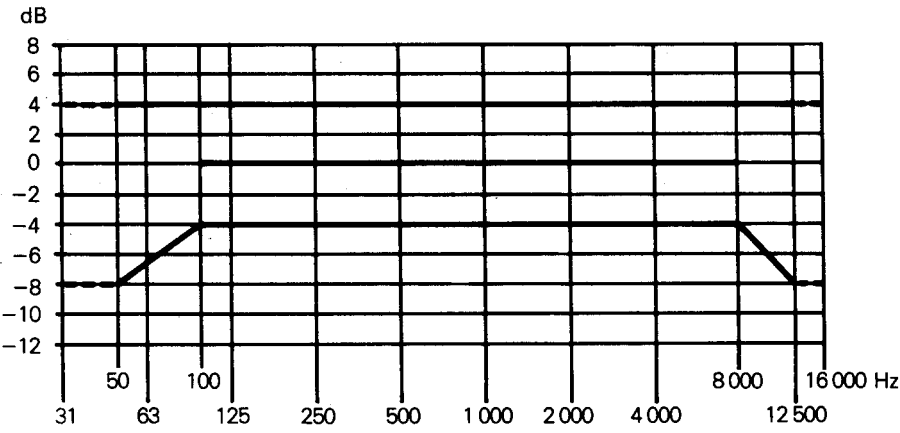
P_{ch} = characteristic power, watt

$L(p_m)$ = mean characteristic sound pressure level determined with an input power of 1 W in each $\frac{1}{3}$ octave band

Note. — This conversion formula assumes that the sensitivity of the loudspeaker does not change over the input power range from 1 W to the characteristic power. Since in some cases this assumption may not be justified a check should be made, that, when the characteristic power is applied, the required sound pressure level of 94 dB is in fact obtained. If this is not obtained an appropriate correction to the calculated value of the characteristic power is necessary.

SECTION ONE – MINIMUM REQUIREMENTS FOR CHARACTERISTICS
DIRECTLY RELATED TO THE REPRODUCING QUALITY

Clause	Characteristic	Method of measurement	Minimum requirement
6.	Frequency response	According to the clause of IEC Publication 268-5 "Frequency response", using narrow-band noise The measurement shall be carried out under free field conditions for both types of loudspeaker referred to in Sub-clause 3.2 of this standard. For wall or shelf mounting loudspeakers the measurement shall also be carried out under the half space conditions given in Item b) of Sub-clause 3.2 The resulting curve and that from the free field measurement shall then be superimposed so that they coincide at a frequency given by $f = \frac{360}{a} \text{ Hz}$ where a is the smaller dimension of the frontal area of the enclosure in metres The composite curve, formed by the half-space response at low frequencies and the free field curve at higher frequencies shall then be taken as the frequency response for determining the compliance with the minimum requirements of this clause <i>Notes 1.</i> — This procedure is adopted pending the completion of the studies on this subject 2. — If the measurement is carried out with an input power of 1 W in each $\frac{1}{3}$ octave band the resulting mean characteristic sound pressure level can be used to calculate the characteristic power of Sub-clause 5.1 according to the method given in Sub-clause 5.2.1	From 50 Hz to 12 500 Hz mid-band frequencies (mean frequencies in each $\frac{1}{3}$ octave band), within the tolerances defined by the diagram of Figure 2, page 5, in which the 0 dB line is the mean characteristic sound pressure level of the measured frequency response curve between 100 Hz and 8 000 Hz (see Sub-clause 5.2 of this standard)

Clause	Characteristic	Method of measurement	Minimum requirement
7.	Effective frequency range	According to the clause of IEC Publication 268-5 "Effective frequency range", but related to the mean characteristic sound pressure level calculated between 100 Hz and 8 000 Hz according to Sub-clause 5.2 of this standard	Frequency limits (in terms of the mean frequencies of the relevant third-octave bands) are given for the points where the amplitude/frequency curve intersects the abscissa -8 dB, both in the bass and treble registers (see Figure 2). If the claimed effective frequency range is wider than the minimum requirements of 50 Hz and 12 500 Hz the tolerances of -8 dB and +4 dB still apply
			
		FIGURE 2	
8.	Directional response	According to the clause of IEC Publication 268-5 "Directional response pattern" (with frequency response curves at various angles from the reference axis)	Frequency response curves shall be measured at stated angles from the reference axis of between 20° and 30° in a horizontal plane and between 5° and 10° in a vertical plane, on both sides of the reference axis in each case The curves shall fall within a tolerance field of ± 4 dB referred to the curve measured on the reference axis (Clause 6 of this standard) from 250 Hz to 8 000 Hz. The curves shall be aligned so that the low frequency portions (where the loudspeaker is substantially non-directional) coincide. The manufacturer shall state the exact angle at which the relevant frequency curve is measured <i>Note.</i> — The wide angles for the minimum requirements in a horizontal plane are based on the fact that loudspeaker systems for stereophonic use are very often placed with their radiating surfaces in line in the same vertical plane, which means that a more extensive uniform response in the horizontal plane is desirable. The narrow angles for the vertical plane however are sufficiently wide to prevent severe subjective effects without making unduly difficult the positioning of the driver units in multi-way speaker systems.

Clause	Characteristic	Method of measurement	Minimum requirement																								
9.	Difference of amplitude/frequency response (for stereophonic loudspeaker systems)	See Clause 6	The response curves obtained along the reference axis for loudspeakers of the same type, intended to be used in stereophonic installations, shall be such that the average sound pressure levels, corresponding to each of the octaves whose mid-band frequencies lie between 250 Hz and 8 000 Hz inclusive, do not differ by more than 2 dB from one speaker to the other for the same octave. A transfer to equalize the values obtained for the 1/2 octave with a mid-band frequency of 1 000 Hz is carried out previously. Verification of the fulfilment of this condition is obtained by using the results of the test of Clause 6, summing the sound pressures corresponding to the 1/2 octave bands centred on the following frequencies, using the formula of Sub-clause 5.2 (mean characteristic sound pressure p_m): <table><tr><td>1st octave</td><td>200</td><td>250</td><td>315 Hz</td></tr><tr><td>2nd octave</td><td>400</td><td>500</td><td>630 Hz</td></tr><tr><td>3rd octave</td><td>800</td><td>1 000</td><td>1 250 Hz</td></tr><tr><td>4th octave</td><td>1 600</td><td>2 000</td><td>2 500 Hz</td></tr><tr><td>5th octave</td><td>3 150</td><td>4 000</td><td>5 000 Hz</td></tr><tr><td>6th octave</td><td>6 350</td><td>8 000</td><td>10 000 Hz</td></tr></table>	1st octave	200	250	315 Hz	2nd octave	400	500	630 Hz	3rd octave	800	1 000	1 250 Hz	4th octave	1 600	2 000	2 500 Hz	5th octave	3 150	4 000	5 000 Hz	6th octave	6 350	8 000	10 000 Hz
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6th octave	6 350	8 000	10 000 Hz																								
10.	Characteristic total harmonic distortion	According to the clause of IEC Publication 268-5 "Characteristic harmonic distortion" at a constant input voltage 4 dB below the voltage corresponding to the characteristic power (Sub-clause 5.1 of this standard) and under normal measuring conditions The characteristic power shall be that for the particular loudspeaker being measured, and not the rated value of the characteristic power	— from 250 Hz to 1 000 Hz < 2% — above 1 kHz to 2 kHz < 2% down to < 1% decreasing linearly with respect to a logarithmic frequency scale — from 2 kHz to 6.3 kHz < 1% Individual (3 at the most) distortion peaks, exceeding the respective tolerance limit, shall be disregarded unless their width at the tolerance limit is more than 1/2 octave																								
11.	Impedance	According to the clause of IEC Publication 268-5 "Rated impedance"	For any setting of the controls available to the user, the impedance shall be not less than 80% of the rated impedance at any frequency within the range 20 Hz to 20 000 Hz <i>Note.</i> — Control of the impedance to the same minimum value outside this frequency range is desirable in order to avoid problems with certain types of amplifiers.																								

Clause	Characteristic	Method of measurement	Minimum requirement
12.	Short-term maximum input voltage/power	According to the clause of IEC Publication 268-5 "Short-term maximum input voltage" and "Short-term maximum input power"	To ensure satisfactory operation, reference should be made to the matching conditions of IEC Publication 268-15* "Matching of amplifiers and loudspeakers"
13.	Long-term maximum input voltage/power	According to the clause of IEC Publication 268-5 "Long-term maximum input voltage and power"	
14.	Interconnection: <i>a) mechanical</i> <i>b) electrical</i>		According to IEC Publication 268-11** <i>Note.</i> — The 130-9 IEC-05/06/07/08/09 connectors described in IEC Publication 268-11 are not suitable for currents in excess of 4 A or peak voltages in excess of 34 V. Furthermore these connectors are not suitable for some kinds of loudspeaker cable. For this reason other means of connection are permitted at present. According to IEC Publication 268-15
15.	Characteristics to be specified		Generally, according to the clause of IEC Publication 268-5 "Characteristics to be specified" but only the characteristics listed in this standard, with the exception of the mean characteristic sound pressure level (Sub-clause 5.2) and the directional response curves (Clause 8) are mandatory in the manufacturer's manual, descriptive leaflet or technical specification. This shall include a statement of the intended use of the loudspeaker for example "wall-mounting" or "free standing", and the test environment (see Sub-clause 3.2).

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Clause	Characteristic	Method of measurement	Minimum requirement
16.	Instructions for loudspeaker kits		For loudspeakers marketed as kits, the manufacturer shall, in addition to the requirements of the preceding clauses, also supply: 1. Detailed electrical and mechanical assembly instructions, including a diagram showing the electrical connections of components. 2. If the parts forming the enclosure are not supplied with the kit, the manufacturer shall include construction drawings, comprising details of each part and a 1:1 scale cutting mask for the front plate. Accompanying this shall be a complete description of materials, using easily procurable standard dimensions and unambiguously identifying each material by a commonly used brand name on the respective market.

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Review of Indian Standards

Amendments are issued to standards as the need arises on the basis of comments. Standards are also reviewed periodically; a standard along with amendments is reaffirmed when such review indicates that no changes are needed; if the review indicates that changes are needed, it is taken up for revision. Users of Indian Standards should ascertain that they are in possession of the latest amendments or edition by referring to the latest issue of 'BIS Catalogue' and 'Standards : Monthly Additions'.

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Amendments Issued Since Publication

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